concerns have announced their intention of investing capital in Cuba in the development of the fisheries.

The Institute is taking the necessary steps to establish an aquarium, a museum and a library. It is conducting studies of technology and of methods of repopulation of the rivers and other fresh waters. It is planning the construction of freezing plants, the formation of fishermen and boat owners' cooperatives and the establishment of schools where fishermen's sons will be taught methods of fishing.

It should be emphasized that Cuba, by virtue of its geographical position, is ideally located for fishing activities and for production of marine products, not only for its own use, but also for export to other countries. In the fisheries and in other marine enterprises investors may find in Cuba excellent opportunities. The National Institute of Fisheries will gladly furnish information to all persons—industrialists, administrators or scientists—who make requests about prospects and conditions in Cuba.

Marine Fisheries of the Yucatan Peninsula, Mexico

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THIS PAPER is a progress report on the investigations of the fisheries of the Yucatán Peninsula, México, carried on by the author from 1954 to the present, under the auspices of the Mexican Institute of Natural Renewable Resources and the Fisheries Department of México.

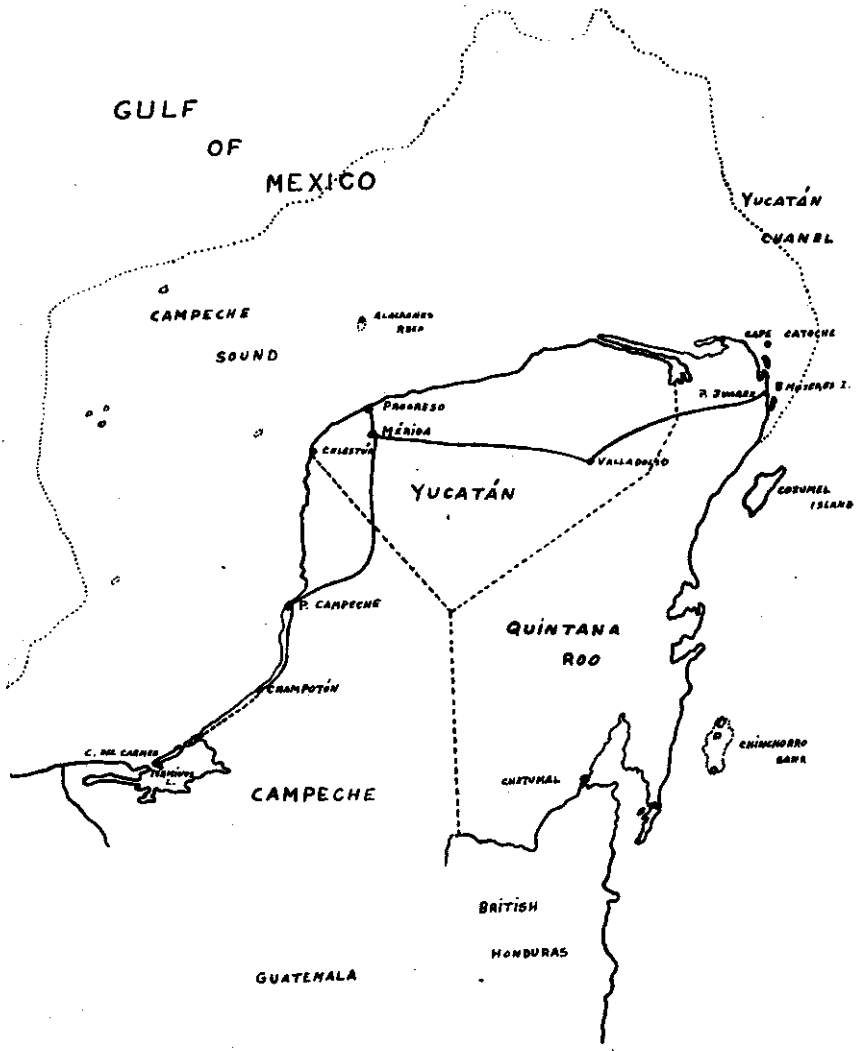
The zone of study, called "the Southeast," includes the States of Campeche and Yucatán, and the Territory of Quintana Roo. The two states are located on the Gulf of México, while Quintana Roo faces the Caribbean, with British Honduras on the South.

The Peninsula has an area of about 138,000 square kilometers (54,000 square miles), and a very low index of population. The main cities, and therefore the main markets within the Peninsula, are Mérida, Campeche, Chetumal, Progreso, Ciudad del Carmen, and Valladolid. There is no exact

[illegible] lack of appreciation for sea food, as the "Yucatecos" have been great fish consumers since the times of the Mayan Empire.

Local transportation facilities are very limited. The only important highway goes from Puerto Juarez on the Caribbean (a port planned for construction in front of Isla Mujeres) to Campeche and the small town of Champotón, passing through Mérida. From the main highway, several minor roads take off to smaller towns. In Quintana Roo, transportation is done by mule, "plataforma"—a railroad car without cover, moved by animal traction—boat, or plane. The only land communication between the Peninsula and the rest of the country is the railroad, but most fresh or frozen fishery products are distributed by air. There is an important road under construction that will link Yucatán to the rest of México, but as it has to cross very rough and swampy country, it will not be ready until 1959 or 1960.

Campeche Sound includes the continental shelf from about Términos



Lagune to Isla Cancún. Its maximum width is found in front of Yalkubú Point where it extends for more than 250 km. and becomes narrower towards the State of Tabasco. Two different types of bottoms are found in the Sound, a calcareous bottom densely sprinkled with coral patches and banks, that extends from about Champotón to the Yucatán Channel, and a sedimentary type south of Champotón, composed of mud and sand, where most Mexican shrimp trawlers operate.

Production comes from the Campeche Sound almost entirely. The main fishing areas are: 1) some coastal and estuarine waters of Campeche and Yucatán; 2) the area of the keys and islands of the Sound; and 3) the Yucatán Channel.

Fishing equipment ranges from the hand line, responsible for the bulk of the fin-fish catch, to the modern otter trawl. There is very little mechanization, except in the shrimp fishery, and even in snapper fishing at great depths, lines are operated by hand. Drift gill nets are widely used for small sharks, rays, pompano, and many other coastal and estuarine fishes. Beach seines are responsible for a small part of the catch, and cast nets, although very popular, serve mostly for the capture of bait. Long lines and trot lines are seldom if at all used. In northern Quintana Roo and Alacranes Reef, traps and bully nets are employed in the capture of spiny lobster.

Fin fishing is carried on from small sail boats of less than five tons, operating in protected waters or close to shore. In the capture of sharks off the northern coast of Yucatán the same craft, with no other navigational aid than the compass, and with the fishermen depending on their own intuition as indication of possible weather changes, go out for more than 40 km (25 miles) in search of the catch. In the grouper and snapper fisheries, the fleet is somewhat larger, ranging in size from five to twenty tons.

By far the main fishery of Yucatán is for shrimp. Of secondary importance are groupers, snappers, sea turtles, mojarras, snook, sardine, and many other estuarine and littoral species.

The Mexican shrimp fishery of the Gulf of México has had a very rapid development. For ten years after the discovery of commercial concentrations of the crustacean by the Japanese exploratory fishing vessel ***Sapporo Maru*** in 1936, there were no shrimping activities, but in late 1946 some American boats based in ports of the United States, began trawling for shrimp in the Campeche Sound with the authorization of the Mexican Government. Since the trip across the Gulf was expensive and time consuming, some companies settled at Ciudad del Carmen and established freezing plants, some still in operation. The industry began to grow rapidly and due to the high prices national as well as foreign capital was invested in new shrimp trawlers and plants. By 1954, only eight years after the first boats began operations, more than 200 Mexican trawlers were fishing the Campeche Banks and a larger number of American craft were exploiting the same grounds.

Mexican shrimp trawlers are modern boats ranging from 20 to 90 tons. Many were purchased in the United States, but most of them were built in Ciudad del Carmen or Campeche. They operate in less than 25 fathoms of water from about Champotón to Tabasco and it is very uncommon to find them as far away as any of the keys of the Sound or north of the port of Campeche.

The catch is handled by 11 freezing plants, 10 established at Ciudad del Carmen and one at Campeche. Almost all the production is exported to the United States.

The same species of shrimp caught along the Gulf coast of the United States are fished in México; the pink shrimp (*Penaeus duorarum*) is found from south of Campeche to Cape Catoche, but only some restricted areas have suitable trawling bottoms; white shrimp (*P. setiferus*) goes from about Celestún, Yucatán, south, from shore to the 20 fathoms contour and the brown shrimp (*P. aztecus*) follows approximately the same distribution as the last one, but in deeper waters. As is to be expected, this distribution is not as sharply cut as mentioned, often overlapping on its neighboring lines, and it is not infrequent to find individuals of one species far from their usual zone of distribution.

There is no fishing for shrimp in estuarine or inland waters, except for a dwarf species (*Palaemon* sp.), caught in large numbers in the neighborhood of the port of Campeche. This tiny decapod of not more than two inches in size, the largest individuals, are headed, peeled, and served as shrimp cocktails in restaurants, often taking close to a hundred of them to fill up a glass.

Second in importance is the grouper fishery that operates in all the banks close to shore from about Celustún to Isla Mujeres. The main species taken is the common red grouper (*Epinephelus morio*), but other serranids, as the spotted jewfish (*Promicrops itaiara*), the nassau grouper (*Epinephelus striatus*) and several species of snappers are included in the catch. The fishing fleet is composed mainly of sail boats of three to 15 tons, with some smaller than three and a few larger than 15. Fishing is done by hand lines, without the help of mechanical devices, in waters up to 50 fathoms depths. The bulk of the catch is frozen or salt dried, with only a small part being sold fresh. There is a freezing plant at Progreso that sends the product by air to México City or by boat to Puerto Rico. This resource, although rather heavily exploited, could withstand more intensity of fishing, but larger craft with auxiliary motors and mechanized fishing equipment are needed in order to reach new or underdeveloped grounds.

Turtle fisheries are carried on all along the coast from Campeche to British Honduras and, to a certain extent, in the islands of the Campeche Sound, but it is only organized in the Yucatán Channel area, from south of Isla Mujeres to Cape Catoche. The three main commercial species of marine turtles, the hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*) and green turtle (*Chelonia mydas*) are present in large quantities, but only the last one is subject to exploitation in large scale. Loggerhead supplies a restricted local market; the hawksbill, of some importance in the past for its precious shell, is seldom captured now.

Fishing with nets is responsible for the bulk of the catch. Harpoons, or the primitive method of turning the turtle on its back as they come to shore to lay during the breeding season, are also methods employed for catching turtles. All the catch from the Yucatán Channel area is taken to Isla Mujeres where the turtles are kept alive in weirs until a boat comes and carries all the green turtles to Tampa, Florida, the main market for the product.

It is felt that the present production could be increased by extending the fishery to more southern waters of Quintana Roo and by including the loggerhead in the catch, a species for which a national market could be developed with appropriate advertising and sales promoting campaigns.

Prior to 1939 there was an important population of sponges inhabiting the waters of Quintana Roo, which was harvested with some intensity, but the same disease that depleted the beds of British Honduras, Cuba, Florida, and the Bahamas in 1938-39, cleared off the stock to such an extent that the population, although now lightly fished, and this only in the north, has never recovered.

The rest of the fisheries production of Yucatán is made up of littoral and estuarine species like small sharks, mojarras, snook, croakers, pompanos, sardines, barracudas, etc. Bottom dwelling forms such as spiny lobsters and sea snails (*Strombus* spp.) are plentiful off Quintana Roo, but are captured only in limited numbers for local consumption. Shark fishing was an important

industry in the past, but is now reduced to a few areas where operations are carried out on a small scale.

The poor state of development of the fisheries of the Yucatán Peninsula shows a remarkable contrast to the vast resources of its waters. The causes for this situation should be looked for in economic rather than biological conditions. Among the most important ones are lack of financial assistance for anything outside the shrimp fishery, transportation difficulties within the Peninsula and with the rest of the country, inadequate cold preservation and cold storage facilities, and insufficient markets for the production.

In regard to the potential fishery resources, the abundance of spiny lobsters and sea snails in the Caribbean has already been pointed out. Lobster fisheries may be increased considerably, as only a small part of the fishing area is being exploited, while sea snails of the genus *Strombus* and *Melongena* could easily sustain a canning industry similar to the abalone industry of Baja, California.

A survey of the bottoms suitable for sponge culture is needed, as there are indications that sponge farming could be an important development in the Yucatán Peninsula. The author has estimated the existence of about 300 square kilometers (117 square miles) of such bottoms in the Mexican Caribbean, which means that other ecological conditions being appropriate, they could produce over 600,000 kg of cultivated sponges annually. The figure may seem high but it may be well below the actual number if we consider the results obtained by Moore (1910) in Florida, Smith (1948) in the Bahamas, or the Japanese at the Ailinglapalap Atoll (Cahn, 1948).

Small sharks are captured in tremendous quantities in shallow waters and perhaps an increase in production should not be recommended, but on the other hand, fishing for large sharks offers great possibilities as a consistent source of animal protein in the form of dried meat that could easily reach poorly communicated towns without cold storage facilities. The low price that makes shark meat of importance, can be sustained by the profit obtained from the livers and hides. For those not familiar with the product it must be said that when properly processed it makes a fine substitute for dried cod.

In the Caribbean the most important resources are the pelagic species, such as the sharks, fish of the mackerel family, sardines, barracudas, probably the tunas, sea turtles, and others. Demersal groups are abundant, but the volume is dispersed in several species, an important inconvenience from the marketing point of view, for its proper utilization.

On the Gulf of México, however, fishing for estuarine and some continental pelagic species such as squids, sharks, jacks, sardines, and mackerels, could account for an important increase in production. It is suspected that commercial quantities of menhaden may occur in the waters of the state of Campeche, and the survey of the United States exploratory fishing vessel *Oregon* has given evidences of exploitable concentrations of bluefin tuna in deep waters off the continental shelf. Perhaps the main potential resource of the Gulf of México for Yucatán lies in the demersal fin fisheries, at present almost entirely in the hands of foreign fishermen.

All the necessary conditions for the development of the marine fisheries of Yucatán being at hand, a prosperous future for this important industry can be forecast.

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Developing A Caribbean Fishery

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THE ISLANDS OF THE WEST INDIES are mostly divided by vast stretches of water, often with 100 miles or more between islands. As a consequence, the islands have been isolated in their approach to fishery development. This paper is not directed to any particular scientific approach to the problem that confronts fishery development for the West Indies, but is a suggestion for the persons administering fishery matters for the area.

In August, 1956, the islands of the British West Indies agreed to become a Federated British West Indies. With some general agreement now possible between the British islands, it is felt that a quicker approach to fishery development may now be possible. It is hoped that West Indian islands of other nations might be encouraged to join with the new union in a general approach to fishery matters, and it is suggested that the time has arrived when it should be possible to zone the islands of the Caribbean into areas of fishery research. Each zone would then approach their research problems on some organized plan which would have some relation to the research work being undertaken in the neighboring zones.

To carry out the necessary research each zone would be required to establish a number of research boats, equipped to develop and explore new types of gear and techniques, always bearing in mind that the fishermen and boat-owners of the Caribbean are usually persons of limited means. Elaborate ships are not required, but rather a number of good 30-40 foot sea-worthy diesel powered boats, fitted with two engines to create confidence and with the necessary instruments for communication and navigation, and manned by capable West Indian seamen.

Research, as is being suggested in this development program, is of a long term nature, and the islands should be prepared to join in these experiments for a term of at least ten years.

Fishery development affects so many aspects of fishery matters that the entire structure on the respective islands must come in for adjustments, so as to fall in line with advances that might be brought about as a result of improved fishery techniques and gear. This may mean a complete change to a better type of boat, which from observations, is the first major problem for almost all of the islands of the Caribbean. A better market price for fish, as against the price of other proteins, may also encourage new blood to enter the fisheries. Research into methods of distribution and storage is required, where large catches may justify such activities.

The suggestion of zoning the islands is not only for matters of research,